

**REMARKS**

This Amendment amends independent claims 13, 20, 22, and 27 and dependent claims 16 and 30.

In the June 3, 2004 Office Action, the pending claims stand rejected over prior art previously cited by the Examiner. In particular, claims 13-21 and 27-34 stand rejected under 35 USC §103(a) for obviousness over WO 97/49477 (“the ‘477 reference”) in view of United States Patent No. 4,187,089 to Hodgson. Claims 22-24 stand rejected under 35 USC §103(a) for obviousness over the ‘477 reference in view of the Hodgson patent and further in view of WO 93/05339 (“the ‘339 reference”). In view of the foregoing amendments and following remarks, Applicants respectfully request reconsideration of the Examiner’s rejections of the pending claims over the cited references.

The pending independent claims were amended to further distinguish the claimed invention over the cited references. The pending independent claims were amended to set forth that the tube of the claimed device for treating a gas/liquid mixture is “substantially vertical” in orientation, and that the divergence element at the end part of the return conduit (i.e., in the reintroduced flow path) substantially prevents liquid creep flow along the rotating means/swirl element. Support for the foregoing changes may be found in the original specification on page 5, lines 5-10 and in the drawings accompanying the original specification. Dependent claims 16 and 30 were amended to delete the word “longitudinal” modifying the “slots” to avoid confusion with the “slots” claimed in dependent claims 14 and 28. Independent claim 27 was also amended to overcome the Examiner’s indefiniteness rejections under 35 USC §112, second paragraph, relating to the inadvertent use of the phrase “rotating means”.

The ‘477 reference discloses a device for treating a gas/liquid mixture. The device includes an inlet (A) for in-feed of the mixture, a flow element (4), an outlet (8), and one or more feedback lines (B, D). The flow element (4) is located in a cylindrical body (2) defining the inlet (A), and includes one or more blades (5) for causing turbulence in the mixture. Outlet (8) is located downstream of the flow element (4) for out-flow of gas flow. Additionally, the one or more feedback lines (B, D) are connected to a recycle channel or conduit (12) arranged centrally in the flow element (4) for discharge as a separated liquid

into a part of the gas flow. An anti-creep flow interrupter (7) is provided on the flow element (4) at the end of channel (12).

The Hodgson patent is directed to a horizontal vapor-liquid separator. The separator (10) includes inlet tubing (18), a pipe (24) coaxially aligned with the inlet tubing (18), and a pair of pipes (36, 38) coaxially aligned with the pipe (24). A baffle (44) is coaxially aligned with pipe (38) and spaced from pipe (38) by axially-extending circumferentially spaced rib members (46). The cone apex of the baffle (44) is directed toward the end of the pipe (38). In operation, the baffle (44) is used to reverse the forward flow of the vapor/liquid mixture in pipes (24, 36, 38) and the liquid droplets impinging on the baffle (44) are coalesced and fall to the bottom of chamber (14). Once the flow stream is substantially free of liquid, gas exits the chamber (14) through exhaust tubing (48). Liquid in the chamber (14) drains by gravity flow into the liquid accumulation chamber (56).

The present invention is directed to an improved device for treating a gas/liquid mixture, also referred to commonly in the art as a separating "cyclone". Such cyclones may be provided in two different forms or embodiments. In the first embodiment, the cyclone includes a main conduit with a swirl body positioned therein for setting a gas/liquid flow mixture into rotation in the main conduit. The centrifugal force acting on the gas/liquid mixture causes separation between the liquid component and the gas component of the flow. An improvement to the "standard" cyclone just described utilizes a feedback or recycle conduit in the main conduit. In such recycle cyclones, a portion of the gas/liquid mixture is discharged laterally through openings in the main conduit wall. A part of the gas/liquid mixture discharged through the openings is discharged directly, while another part of the gas/liquid mixture is discharged through the openings is recycled via the feedback/recycle conduit and reintroduced. The recycle flow is reintroduced into the flow in the main conduit via the feedback/recycle conduit. Such recycle cyclones provide improved separating efficiency than standard cyclones.

A significant problem in the field of separating cyclones, whether standard or recycle cyclones, is liquid creep. Liquid creep relates to liquid flow along the outer surface of the swirl body which enters the outgoing axial flow from the main conduit during operation of the cyclone. The liquid creep flow moves or "creeps" along the outer surface of the swirl body and causes unwanted liquid to enter the outgoing axial flow from the main conduit of the cyclone.

The '477 reference attempts to address the problem of liquid creep flow in a recycle cyclone. The '477 reference addresses the liquid creep flow problem by providing an open liquid creep flow interrupter (7) at the end of flow element (4). The stated function of the liquid creep flow interrupter (7) is to deflect the liquid flow (i.e., creep flow) along the flow element (4) outward, (see page 4, lines 14-20 of the '477 reference). Thus, the explicit stated purpose of the creep flow interrupter (7) is to physically deflect the liquid creep flow along the flow element (4) outward into flow space (3) with a deflecting element. The liquid creep flow interrupter (7) in no way affects the recycle flow passing through flow element (4) via conduit (12), in that recycle flow passes vertically through the unobstructed top opening in the flow element (4).

In operation, the recycle cyclone of the '477 reference will have a portion of the main gas/liquid flow (i.e., primarily liquid) exiting flow space (3) via openings (9) and reenter the main gas/liquid flow through recycle conduit (12). This recycle flow exiting conduit (12) will exit this conduit axially in exactly the same manner as a "standard" recycle cyclone, discussed previously. The recycle flow reentering the main flow inevitably will include a significant percentage of liquid. This liquid will as a result ultimately and undesirably exit the device via opening (8). As indicated previously, the liquid creep flow interrupter (7) will have no effect on the axially discharging recycle flow exiting conduit (12), and therefore will have no effect on the liquid in this flow. In contrast, the presently claimed device will have substantially laterally divergent flow exiting slots (19) which "blows off" liquid creep flow on the swirl element (13), as discussed further hereinafter. Additionally, due to the presently claim divergence element and axial obstruction inducing or causing this substantially lateral flow, the presently claimed device, in operation, virtually eliminates the liquid portion of the axially discharging recycle flow found in the recycle cyclone of the '477 reference. This is because the substantially laterally divergent flow exiting slots (19) in the present device will direct the liquid portion of the axial recycle flow in conduit (16) outward to outlet openings (12) to be recycled again. With each pass through the recycle conduit (16), the liquid portion of the recycle flow is further reduced. The '477 reference and, for that matter, the Hodgson patent does not in any way teach or suggest this concept as embodied in the language of the pending independent claims.

In view of the foregoing background discussion, Applicants respectfully submit that the pending independent claims distinguish over the cited references whether considered

individually or in combination. While the '477 reference discloses a liquid creep flow interrupter (7) and the flow element (4), the liquid creep flow interrupter (7) has absolutely no effect on the recycle or reintroduce flow in flow element (4), which passes directly vertically therethrough. As indicated previously, the stated function of the liquid creep flow interrupter (7) is to physically deflect the liquid creep flow on the outer surface of flow element (4) outward into flow space (3). Thus, the liquid creep flow interrupter (7) is not a "divergence element at an end part of the return conduit for causing the reintroduced flow to divert substantially laterally outward to the return conduit", as required by each of the pending independent claims. More importantly, as indicated, the liquid creep flow interrupter (7) has no effect on the axial flow discharging from the end of the flow element (4). Accordingly, the '477 reference lacks any teaching or suggestion that the recycle flow exiting the flow element (4) has a radial or lateral component induced or caused by the liquid creep flow interrupter (7) as set forth in the pending independent claims. Further, as admitted by the Examiner in page 3 of the June 3, 2004 Office Action, the '477 reference fails to teach or suggest the "axial obstruction" set forth in the pending independent claims.

The Examiner cited the Hodgson patent to overcome the foregoing shortcoming with the '477 reference relating to the "axial obstruction" language in the independent claims, and specifically cited the baffle structure (44, 46) disclosed in the Hodgson patent to overcome this deficiency. Applicants respectfully submit that the Hodgson patent does not overcome this or the other deficiencies with the '477 reference discussed previously.

First, it is noted that the Hodgson patent is directed to a horizontal vapor-liquid separator and includes a horizontal baffle structure (44, 46) for the express purpose of reversing fluid flow in horizontal pipe (24) and allow any liquid droplets impinging on baffle (44) to coalesce and fall to the bottom of chamber (14) under the force of gravity. In contrast, the pending independent claims, as amended, are directed to a "recycle cyclone" device for treating a gas/liquid mixture with a "substantially vertical" main tube or conduit. The Examiner suggests to take the horizontal baffle structure (44, 46), turn this structure 90°, and apply it to the flow element (4) in the vertical recycle cyclone device disclosed by the '477 reference without any teaching or suggestions to do so in either reference. The only motivation for such a radical alteration to the horizontal baffle structure (44, 46) and subsequent "addition" to the flow element (4) is found in Applicants' disclosure.

Accordingly, it is submitted that the Examiner is using Applicants' disclosure as a blueprint or roadmap in an attempt to recreate the claimed invention, and this amounts to impermissible hindsight reconstruction. The Examiner has arbitrarily chosen or selected a specific structure from the Hodgson patent, the horizontal baffle structure (44, 46), altered this structure to extend vertically in manner in which it will no longer function in its intended purpose, and then applied or added this structure to the flow element (4) in the recycle cyclone disclosed by the '477 reference without a teaching or suggestion in either reference directing one skilled in the art to make such an alteration and/or "addition". As a reminder, the stated purpose in the Hodgson patent for the baffle structure (44, 46) is reverse the horizontal flow in the pipe (24) and allow the liquid droplets impinging on the baffle (44) to coalesce and drip to the bottom of the chamber (14) under the force of gravity.

Moreover, one skilled in the art would not have been motivated to make such an "addition" based on the general knowledge and skill of one skilled in the art. In particular, taking into consideration the stated purpose of the horizontal baffle structure (44, 46) which is to reverse the flow in horizontal pipe (24), coalesce or collect liquid from the flow, and allow the liquid to drain away under the force of gravity, one skilled in the art would not likely ignore these specific teachings, which clearly teach away from using the horizontal baffle structure (44, 46) in a vertical orientation. The horizontal baffle structure (44, 46) is adapted to physically block the horizontal flow in pipe (24) so that gravity may act on the liquid portion of the flow to remove this portion from the flow. The Examiner's suggested alteration of the horizontal baffle structure (44, 46) to extend vertically is contrary to the explicit teachings in the Hodgson patent relating to the horizontal baffle structure (44, 46). Moreover, the Examiner's suggested "vertical" alteration of the horizontal baffle structure (44, 46) would completely destroy the primary and explicitly stated purpose of the baffle structure (44, 46), which is to collect horizontally-flowing liquid and allow the liquid to drain away under the force of gravity. As the Examiner is aware, a suggested alteration of a structure cannot render the structure inoperable for its stated purpose, (MPEP §2145, Section X, Paragraph D). In the present case, the Examiner's suggested alteration of the horizontal baffle structure (44, 46) and subsequent "addition" to the flow element (4) will render the horizontal baffle structure (44, 46) inoperable for its intended stated purpose of collecting horizontally-flowing liquid in the pipe (24) and allowing the liquid to drain away under the force of gravity. Applicants respectfully submit that this would exactly be the result of the

Examiner's suggestion relating to the horizontal baffle structure (44, 46), as this structure would no longer be suitable to block a horizontally flowing gas/liquid fluid mixture for the purpose of "coalescing" liquid and draining the liquid away under the force of gravity. Accordingly, the Examiner's suggested "vertical" alteration of the horizontal baffle structure (44, 46) not only runs contrary to the teachings of the Hodgson patent but also destroys the intended purpose for this structure.

Further, assuming, *arguendo*, that there would have been motivation to apply the horizontal baffle structure (44, 46) to the vertical recycle cyclone disclosed by the '477 reference, the natural extension of the baffle structure (44, 46) to the recycle cyclone of the '477 reference is to add the baffle structure (44, 46) to the outlet (8) downstream of the flow element (4) (see Fig. 1 of the '477 reference), rather than to the flow element (4). Applicants have previously established that the '477 reference is devoid of a teaching relating to an axial obstruction, either in the "main" conduit or flow space (3) or in the recycle conduit (12). As will be apparent in reviewing Fig. 1 of the Hodgson patent, there is no recycle or return conduit associated with the horizontal vapor/liquid separator and, therefore, no recycle or return conduit is disposed in the main conduit or pipe (24). Since the horizontal baffle structure (44, 46) is located at the end of the main conduit or pipe (24), the logical application of this structure to the vertical recycle cyclone disclosed by the '477 reference is at the end of the outlet (8) downstream of the flow element (4). To apply this structure to the flow element (4) is not supported by the disclosure of the two cited references. Once again, the only place such a teaching or suggestion (i.e., to apply the baffle structure (44, 46) to flow element (4)) may be found is in Applicants' disclosure and this amounts to impermissible hindsight reconstruction. Simply put, neither of the cited references includes a teaching or suggestion of associating the baffle structure (44, 46) with a "recycle" conduit in a vertically-orientated cyclone device.

The presently claimed device is adapted to address the liquid creep flow problem discussed previously that occurs in vertically-oriented recycle cyclones. As shown in Fig. 2 of the present application, the divergence element and axial obstruction operate to induce or cause the recycle flow to diverge substantially laterally outward from the return conduit. This laterally divergent, outward flow has the effect of "blowing off" the liquid "creeping" up the body of the swirl element (13). Thus, the "liquid creep flow interrupter" set forth in the pending independent claims is the substantially lateral outward flow from the return conduit

caused by the divergence element and axial obstruction. Since the '477 reference already includes such a liquid creep flow "interrupter" in the form of the liquid creep flow interrupter (7), there is simply no motivation, as suggested by the Examiner, to apply the horizontal baffle structure (44, 46) of the Hodgson patent to the flow element (4). Such an addition would be redundant. Since a liquid creep flow interrupter (7) is already present in the '477 reference one skilled in the art would have no need or motivation to add a second such structure to the vertically oriented flow element (4) disclosed by the '477 reference. The Examiner's "addition" of the horizontal baffle structure (44, 46) is unnecessary, redundant, and is contrary to the teachings of the '477 reference. The Examiner's suggested "addition" only makes sense when viewed through the prism provided by Applicants' disclosure, which is hindsight reconstruction.

In view of the foregoing, Applicants respectfully request reconsideration of the Examiner's rejections and allowance of independent claims 13, 20, 22, and 27. The remaining claims depend directly or indirectly from each of the foregoing independent claims and are deemed to distinguish over the cited references for all the reasons discussed hereinabove. Reconsideration of all of the Examiner's rejections and allowance of the pending claims is respectfully requested.

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